PATENT SPECIFICATION

679,751

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COMPLETE SPECIFICATION

Improved Method of and Apparatus for Spray Coating Articles

We, GENERAL MOTORS CORPORATION, a company incorporated under the laws of the State of Delaware in the United States of America, of Grand Boulevard in the City of Detroit, State of Michigan, in the United States of America (assignees of LEWIS J. LAMM, a citizen of the United States of America, c/o General Motors Corporation, Detroit, Michigan, United States of America) do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to methods of and apparatus for spray coating articles.

It has previously been proposed to coat articles electrostatically by setting up an electrostatic field between one or more electrodes and the article to be coated and spraying the coating material into the field. The articles in such a method form an electrode of the system and are either earthed or electrically charged. It has been proposed to set up an electrostatic field between a pair of electrodes which straddle the articles so that the articles lie in the electrostatic field and to project coating material into that field.

The present invention involves coating articles by first charging particles of coating material by projection through an electrical discharge into the vicinity of the articles to be coated so that the atomized coating material may be attracted to the surface of said article.

How the invention, the scope of which is defined by the appended claims, can be performed will be apparent from the following detailed description with reference to the accompanying drawings in which :—

Figure 1 is a longitudinal section of one form of apparatus according to the present invention ;

Figure 2 is a plan on the line 2–2 of Figure 1 ;

Figure 3 is a transverse section on the line 3–3 of Figure 1 ;

Figure 4 is a diagram to illustrate a modification of the present invention ;

Figure 5 is a section on the line 5–5 of Figure 6 ;

Figure 6 is a plan along the line 6–6 of Figure 5 ;

Figure 7 is a section of a modified form of electrode system ;

Figure 8 is a longitudinal section of another form of apparatus according to the present invention ; and

Figure 9 is a transverse section on the line 9–9 of Figure 8.

In the apparatus shown in Figures 1, 2 and 3, a spray booth 2 made from insulating material has top openings 4 and 6 at one end to permit the entrance of articles to be coated, and similar openings 8 and 10 at the other end to permit their exit. The articles 16 to be spray coated are carried into and out of the spray booth through these openings by two monorail conveyors of conventional type 12 and 14. One series of articles 16 enters through opening 4 and passes out through opening 8 ; and another series passes in through the opening 6 and out through the opening 10. Both of these monorail conveyors are maintained at ground potential.

One feature of the present invention is the supply to the spray booth of an inert gas such as carbon dioxide, to minimise fire hazard and decrease the drying and oxidation of the paint previous to its being applied to the articles 16 and 18. Carbon dioxide is preferred since it is heavier than air. For this reason the entrance openings 4 and 6 and exit openings 8 and 10 are advantageously located at the top of the spray booth which acts as a tank for containing the inert gas. If no gas is to be used the openings can be at the ends of the booth.

The spray booth has located at one end thereof (the left-hand end in Figure 1) coating material projectors 20 and 22. If no inert gas is used, these projectors may be conventional type spray guns using air as a pro-

[*Price 2s. 8d.*]

Price 3s. 6d.

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Price 4s 6d

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Price 75p

pellant for the particles of coating material, such as paint droplets. If an inert gas is used, the projectors or spray guns 20 and 22 may be of the solid injection type which depend on placing the paint or like material under very high pressure to obtain atomization and projection. These injection spray guns may be atomizers of the general type used on compression ignition engines. Located directly in front of each of these guns are paint charging electrode systems 24 and 26 which will be described more in detail in connection with the Figures 5, 6 and 7. The paint or other coating material is projected, in this form of the invention, in a direction generally parallel or at an acute angle to the direction of travel of the articles 16 and 18. The overspray in the apparatus used in the present invention is much less than normal: and in order to catch this overspray, a water curtain 28 is used, with an inlet 30 and an outlet 32. This water curtain is maintained at ground potential and therefore electrostatically attracts the charged paint particle overspray.

To minimise the escape of inert gas if used, flexible rubber seals 34 and 36 cover the slots through which the supports 38 and 40 extend. A gas supply tank 42 with a valve 44 replenishes the inert gas in the booth as necessary. Under normal operation this gas is maintained at a sufficiently high level to cover the discharge electrodes 24 and 26 with a non-inflammable atmosphere and preferably sufficiently high to cover the articles 16 and 18: that is to say approximately up to the line 46 (Figure 1).

In operating the apparatus shown in Figures 1, 2 and 3, the spray booth 2 is filled with carbon dioxide or other heavy inert gas from the container 42. The articles 16 and 18 are suspended from the hangers 38 and 40 on the conveyors 12 and 14 and the articles are brought in at one end of the booth and pass out at the other end in parallel paths. Spray coating material is projected from the guns 20 and 22 through the charging electrode systems 24 and 26 so that the particles acquire an electrostatic charge of the same polarity as the pointed electrodes in that system and then continue into the area being traversed by the articles 16 and 18. The electrostatic forces between the charged particles and the grounded articles 16 and 18 attract the particles on to the articles. The particles of coating material, which do not land on the articles 16 and 18, continue through the booth toward the water curtain 28 which is maintained at ground potential so that the overspray is carried away thereby.

The use of an inert gas minimises the liability of sparking at the electrical discharge systems 24 and 26; and as previously indicated, it minimises deterioration of the particles during their travel from the spray guns 20 and 22 to the articles to be coated.

If, as is oftentimes the case, it is desired to use only a single monorail conveyor, the arrangement of Figure 4 can be used. Here the spray from the gun 48 is charged positively by the charging electrode 52 and the articles to be coated 56 are suspended from hangers 58 on only one conveyor and are caused to travel in a direction generally parallel to the direction of spray from the gun 48. The cloud of spray material from the gun 48 being charged positively sets up an electrostatic field between itself and the articles 56. The electrostatic attraction causes the paint particles to migrate to and alight on to the articles.

The form of charging electrode is shown in Figures 5 and 6. A ring of conductive material 60 carries radially disposed, pointed discharge electrodes 62. A second electrode 64 of conductive material and of venturi shape is maintained at ground potential to act as a current collecting electrode having negligible corona discharge. The electrodes 60 and 64 are joined but separated by an insulator 66. The spray gun 68 is located adjacent the narrow end of electrode 64.

A modification of the electrical discharge system is shown in Figure 7 where the current collecting electrode 70 is mechanically attached to but electrically separated from the electrode-carrying ring 74 by the insulator 72. The ring 74 carries a series of inwardly projecting pointed electrodes 76. The difference in this construction is that the current carrying electrode 70 is mechanically and electrically connected to the spray gun 78 so as to form a unit assembly with the gun itself.

The magnitude of the electrical discharge in such systems is a direct function of the potential applied between the electrode and an inverse function of the radius of curvature of the end of said electrode. Pointed electrodes have the smallest possible radius of curvature and by arranging these electrodes in a circle the electrical discharge is concentrated in a compact zone. The cooperating collecting electrode 64, 70 should have a very large radius of curvature to minimise electrical discharges therefrom which would be opposite in polarity to those of the pointed discharge electrodes 62, 76 and therefore would tend to defeat the purpose of the apparatus.

As the minute particles of material are projected through the zone of electrical discharge by the spray guns 68 or 78 they are given an electrostatic charge of the same polarity as that at which the pointed electrodes are charged. The paint particles then pass to the coating area and are deposited

on the conveyed articles which are maintained at ground potential.

The modification shown in Figures 8 and 9 comprises apparatus for spray coating articles having a very large surface area: in this specific instance automobile bodies 80 are illustrated. The spray booth consists of a tunnel 82 made from non-conductive material, having conveyor apparatus 94 for towing trucks 96 carrying the bodies 80. The trucks 96 run on electrically grounded steel rails 98 and 100 so as to maintain the bodies 80 at ground potential. The spray guns 84 and charging electrodes 86 are located in a band around the tunnel. The spray gun electrode system here illustrated is the same as that shown in Figure 7.

The tunnel also has infra-red drying lamps 88 of conventional design and an exhaust fan 90 with a discharge conduit 92 for removing paint fumes from the spray booth. The various discharge electrode systems 86 are here illustrated as having a high negative potential: a positive potential may be equally well used. The spray guns 84 project the coating material at a right angle to the direction of travel of the bodies 80. This angle of projection may be varied as necessary, and may even be parallel to the path of travel of the bodies.

The bodies 80 on conveyor trucks 96 maintained at ground potential, are carried into the tunnel from the right-hand end as shown in Figure 8. As they approach the guns 84 and electrode systems 86, they encounter a cloud of charged paint particles which are attracted to the surface of the bodies so as to completely cover the same. The exhaust fan 90 keeps a current of air flowing past the spray guns toward the right-hand end of the tunnel. After they leave the coating zone and the bodies enter a zone between the discharge electrode systems 86 and drying lamps 88 so that the paint is allowed to spread evenly over the surfaces. The bodies then enter the drying zone formed by the infra-red lamps 88, and are dried in the conventional manner.

It is to be understood that changes and alterations in the specific apparatus above described may be made according to practical requirements, within the scope of the appended claims.

WHAT WE CLAIM IS:—

1. A method of applying a coating material to an electrically conductive article of manufacture, comprising atomizing the coating material, and projecting the atomized material through an electrical discharge into the vicinity of the article to be coated so that the atomized coating material may be attracted to the surfaces of said article.

2. A method according to Claim 1 of applying a coating material to two articles of manufacture simultaneously, comprising: atomizing the coating material and projecting the atomized coating material through an electrical discharge into an area between said two articles of manufacture so that the coating material may be simultaneously attracted to the surfaces of both articles.

3. A method according to Claim 1 or 2, in which the article or articles is or are maintained at ground potential.

4. A method according to Claim 1, 2 or 3, in which the article or articles of manufacture is or are surrounded by an inert atmosphere.

5. A method according to Claim 1, 2, 3 or 4, in which the electrical discharge is entirely surrounded by an inert atmosphere.

6. A method according to any of the preceding claims in which the article or articles are surrounded with an inert gas.

7. A method according to any of the preceding claims in which the atomizing or spray producing means is of the non-pneumatic type.

8. A method according to any of the preceding claims comprising placing the coating material under high pressure and projecting the material by this high pressure without the use of an auxiliary propellant fluid into a zone adjacent the article of manufacture.

9. Apparatus for applying a coating material to articles comprising: means for projecting the particles of coating material, a series of attenuated electrodes radially disposed relative to the path of said particles, a venturi shaped current collecting surface electrode concentric with said path and axially displaced relative to said discharge electrodes.

10. Apparatus for use according to the method of any of Claims 1 to 8, comprising a ring of radially displaced attenuated electrical discharge electrodes adapted to be maintained at a high electrical potential relative to a coaxial ring electrode.

11. Apparatus according to Claim 9 comprising: a tunnel-shaped spray booth, means for drying the coat on the article of manufacture located near the exit of said spray booth, means for exhausting fumes from said booth located near its entrance, means for projecting electrically charged coating material into said booth at points intermediate said drying and said exhausting means, a conveyor capable of maintaining the article of manufacture at ground potential while transporting said article through said booth from the entrance to the exit thereof so that coating material is first electrostatically applied to said article and then is dried on the article.

12. Apparatus for applying a coating material substantially as hereinbefore parti-

cularly described and as shown in the accompanying drawings.

13. A method of applying a coating material substantially as hereinbefore particularly described and as shown in Figures 8 5 and 9 of the accompanying drawings.

E. WILLIAMSON,
Chartered Patent Agent.

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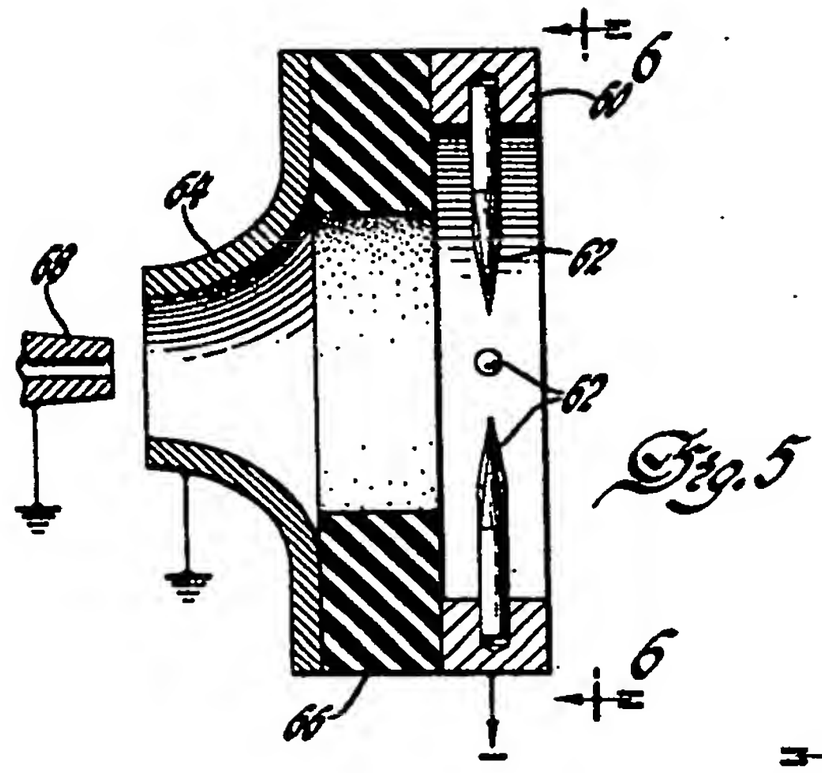


Fig. 5

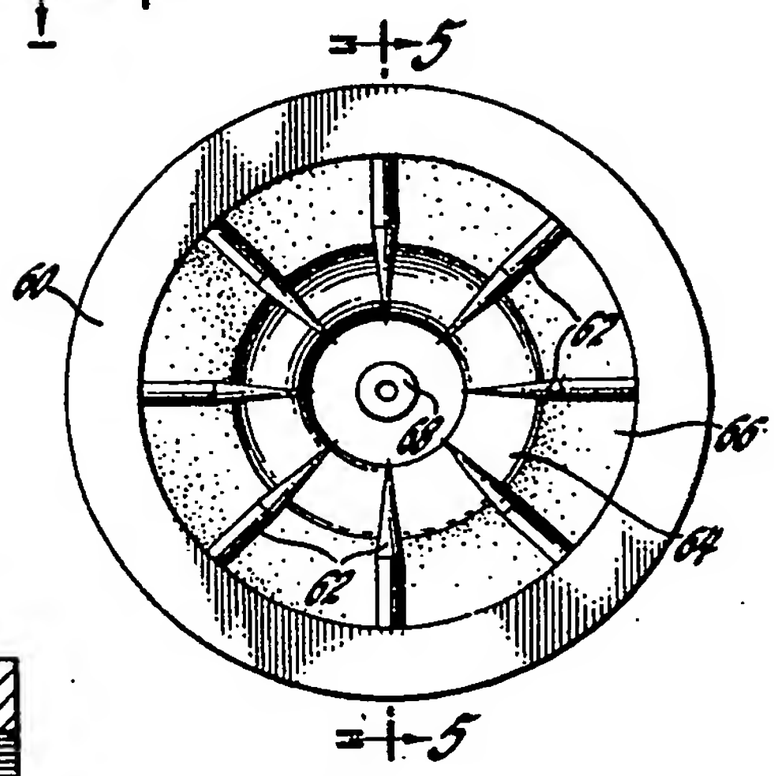


Fig. 6

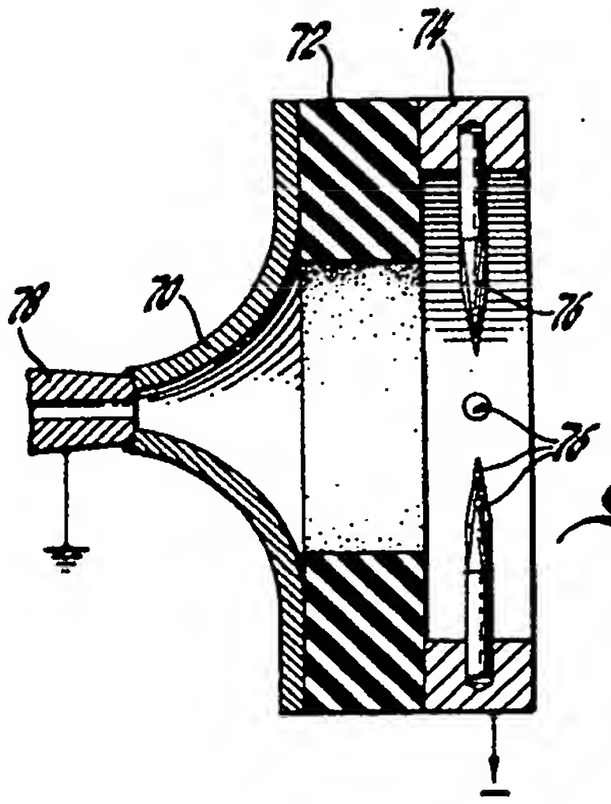
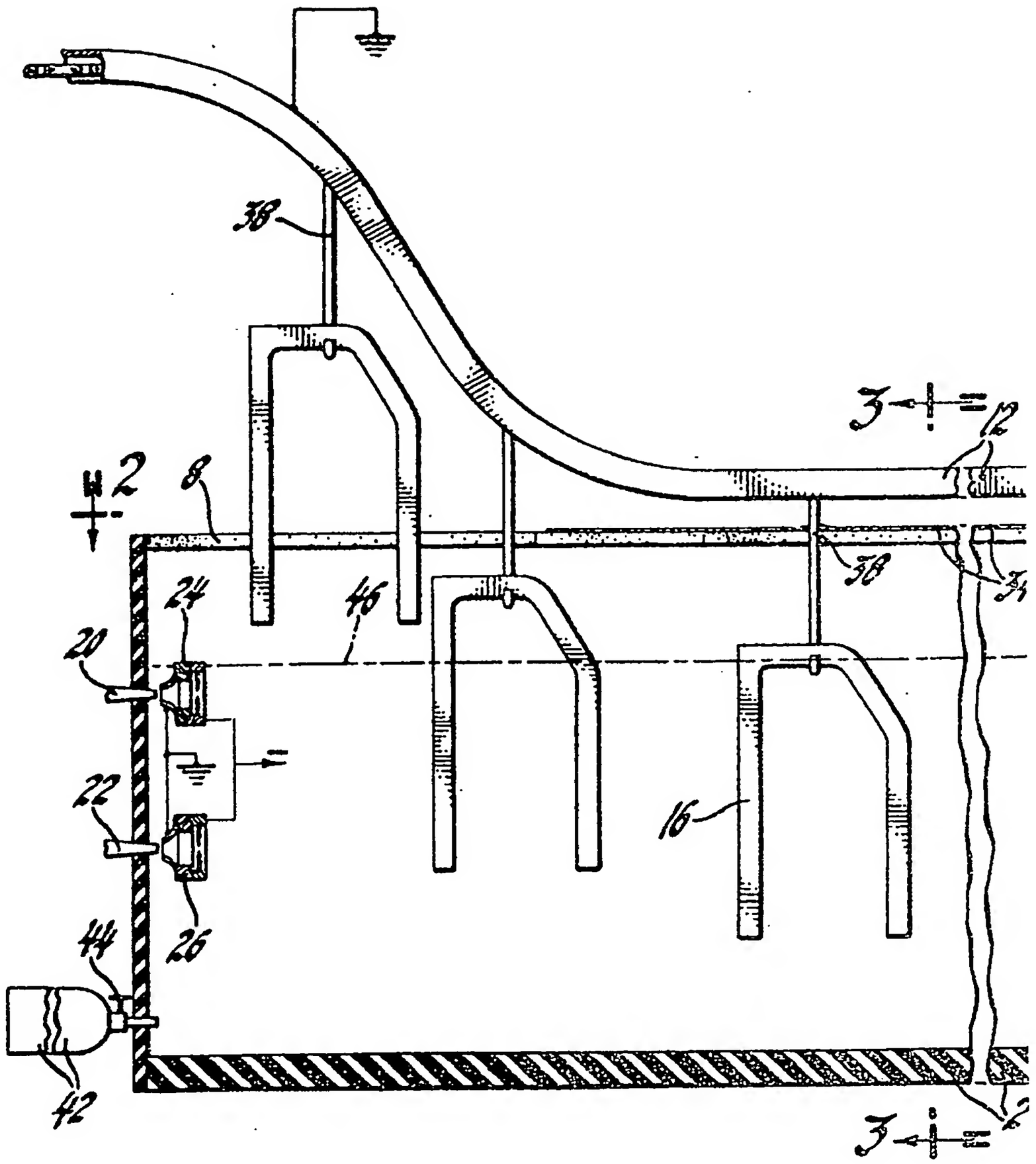


Fig. 7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SHEET 1

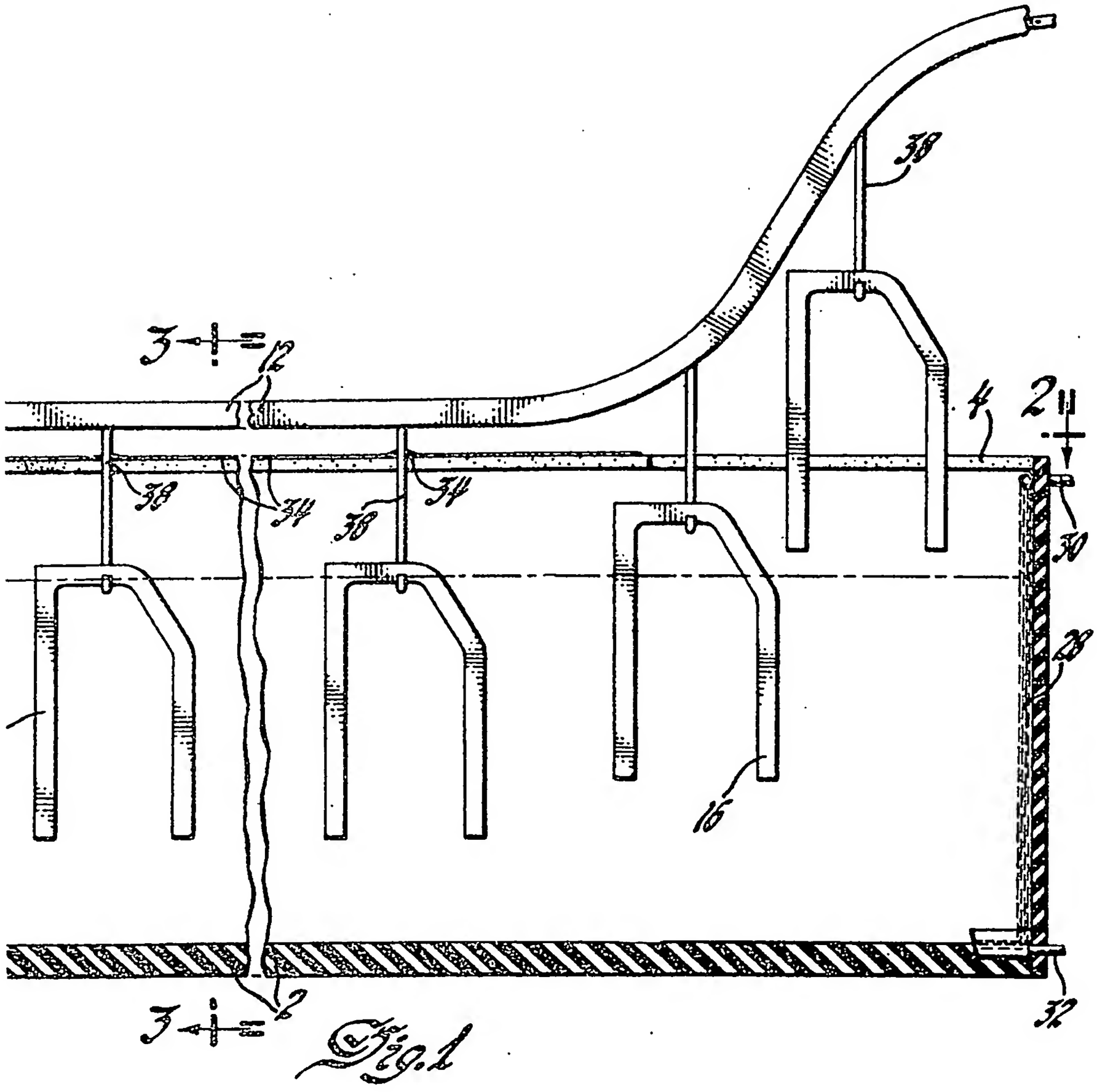

Fig. 1

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SHEET 1

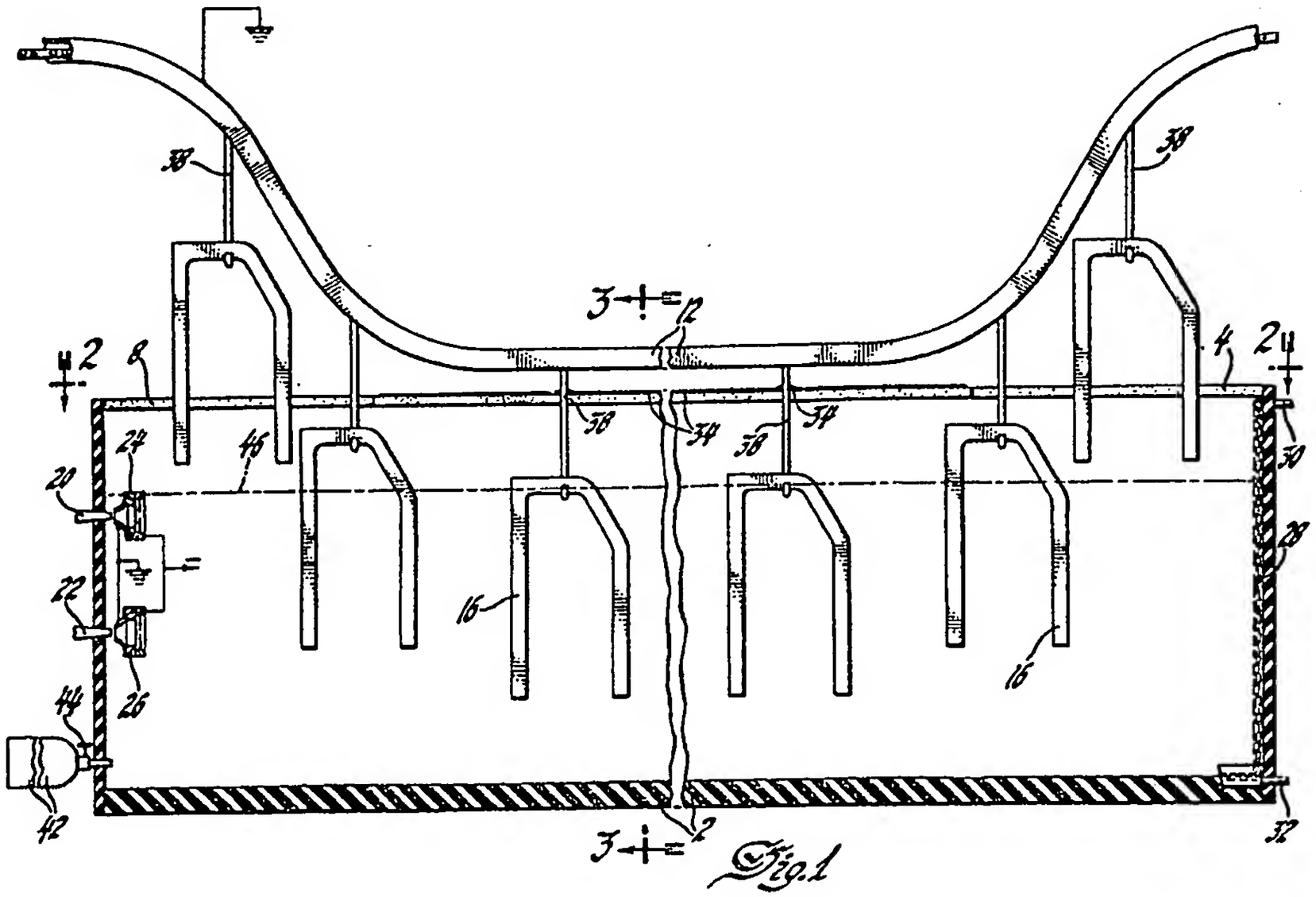

Fig. 1

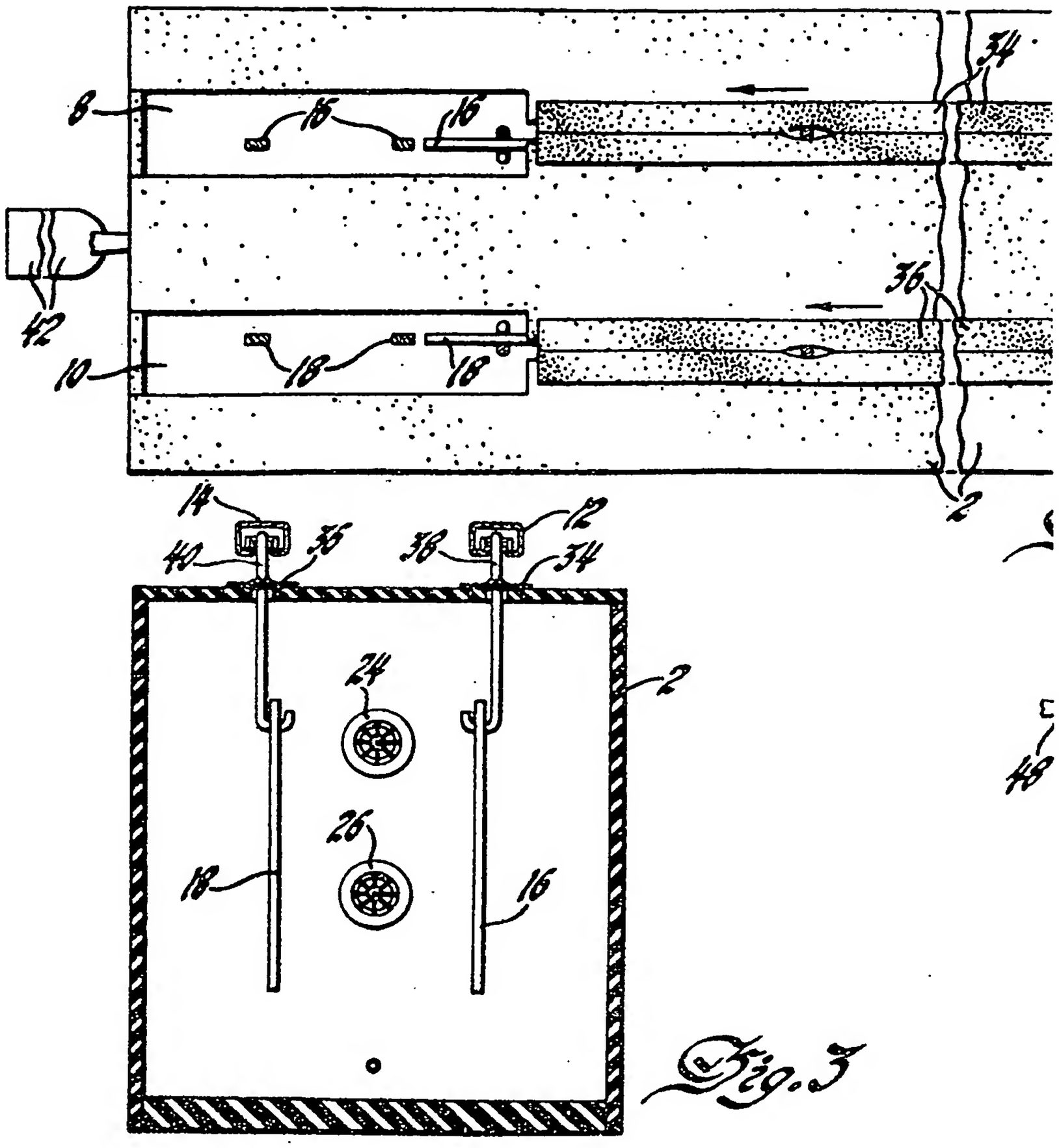

Fig. 3

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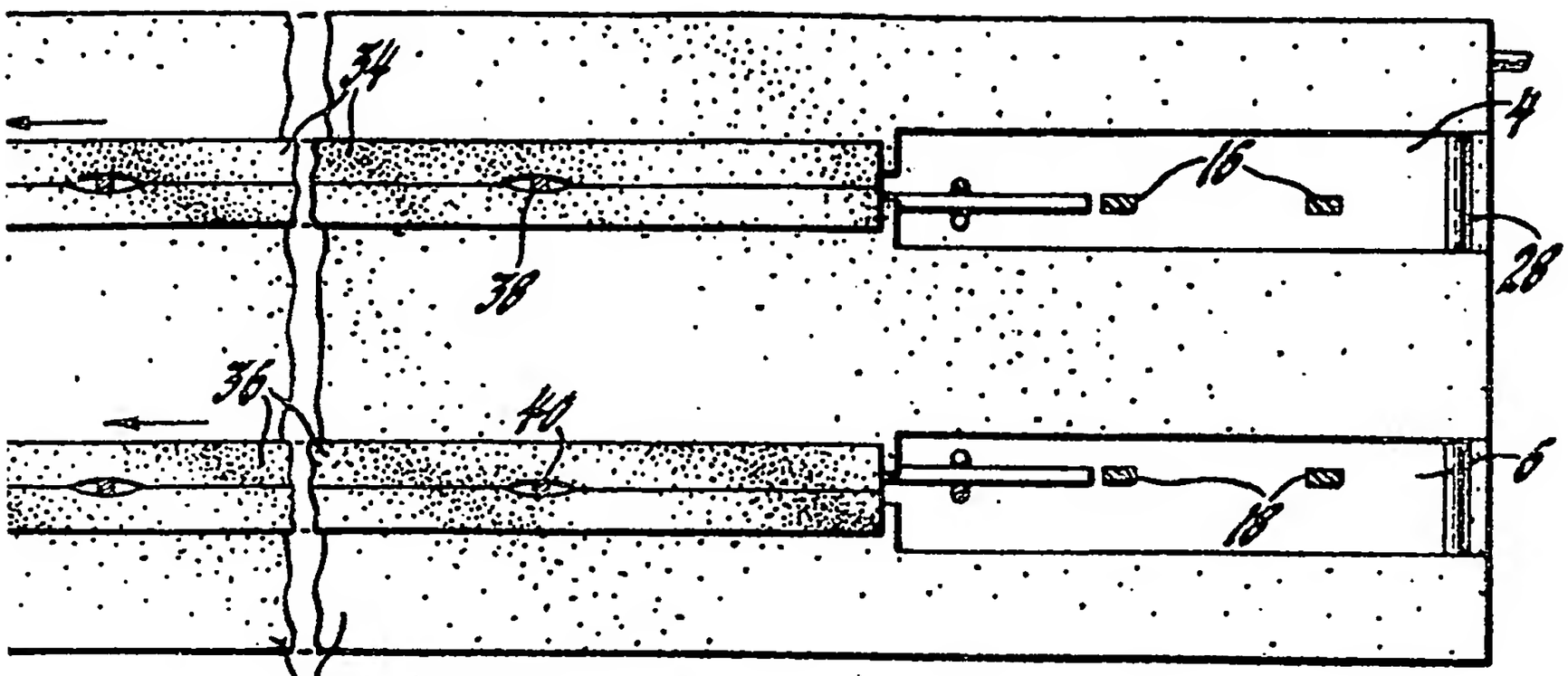

Fig. 2

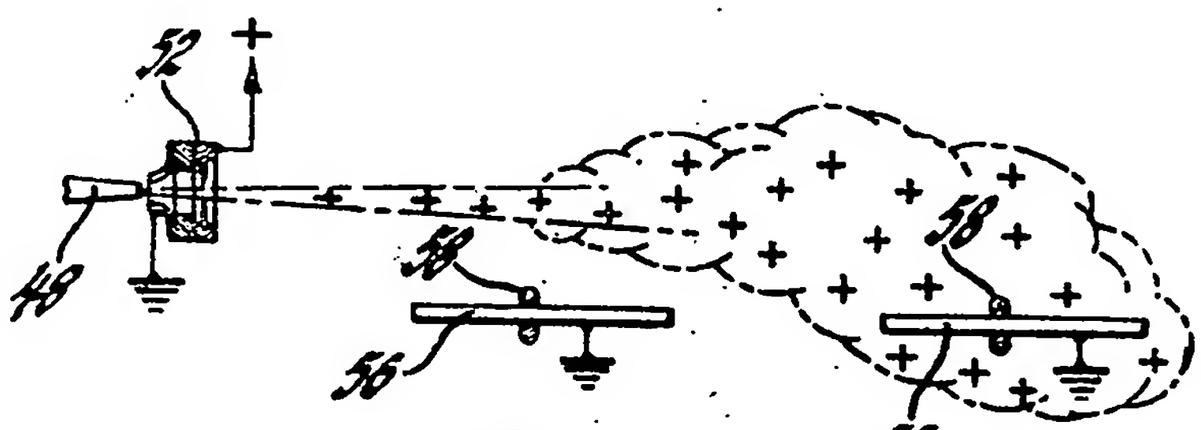

Fig. 4

Fig. 3

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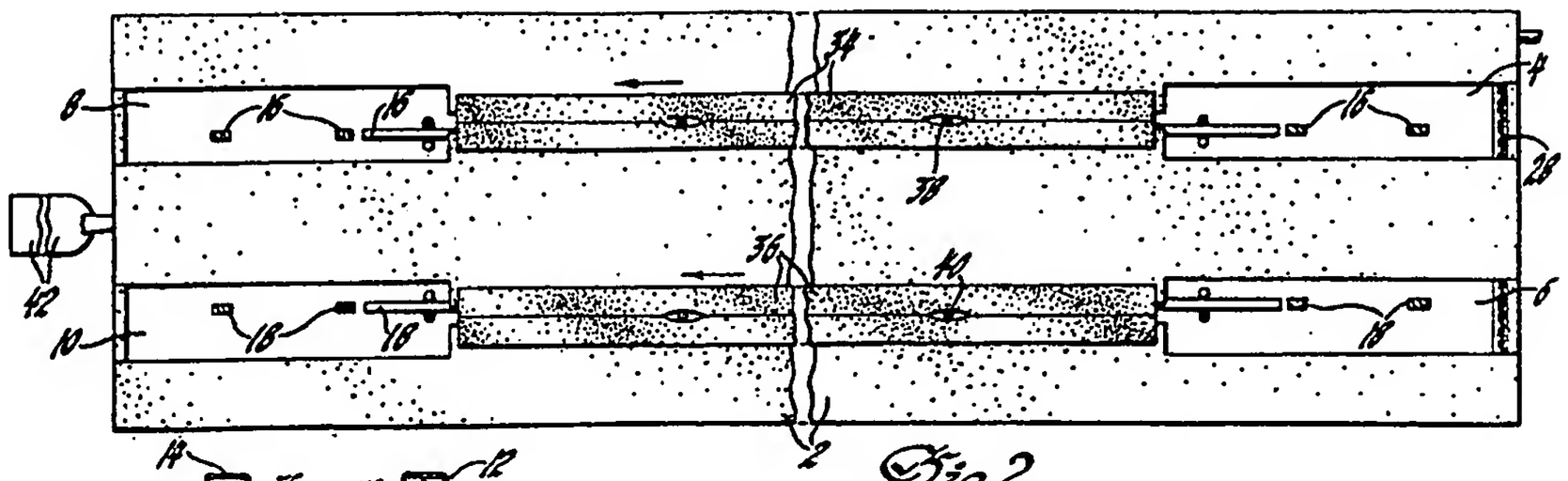

Fig. 2

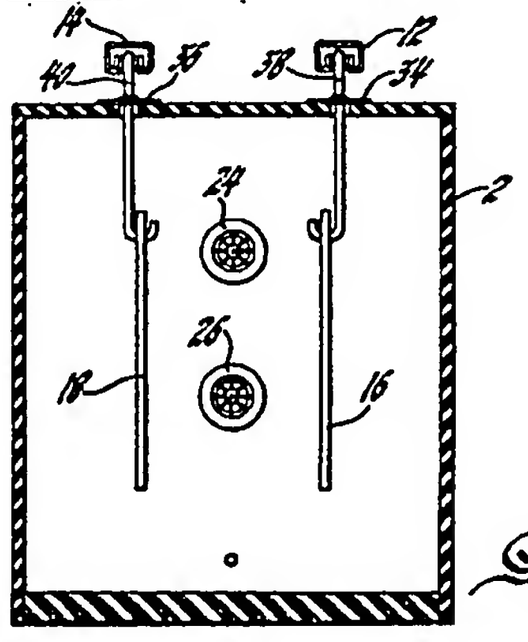

Fig. 3

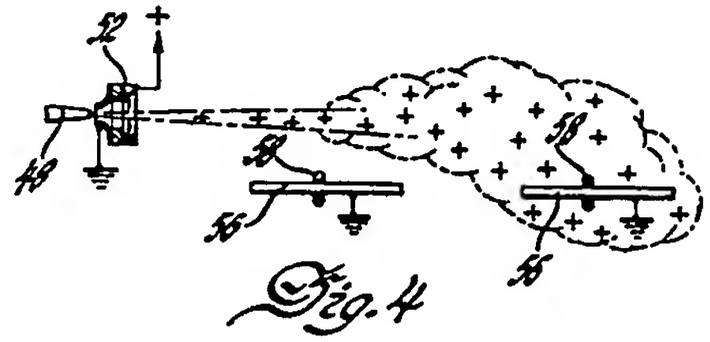

Fig. 4

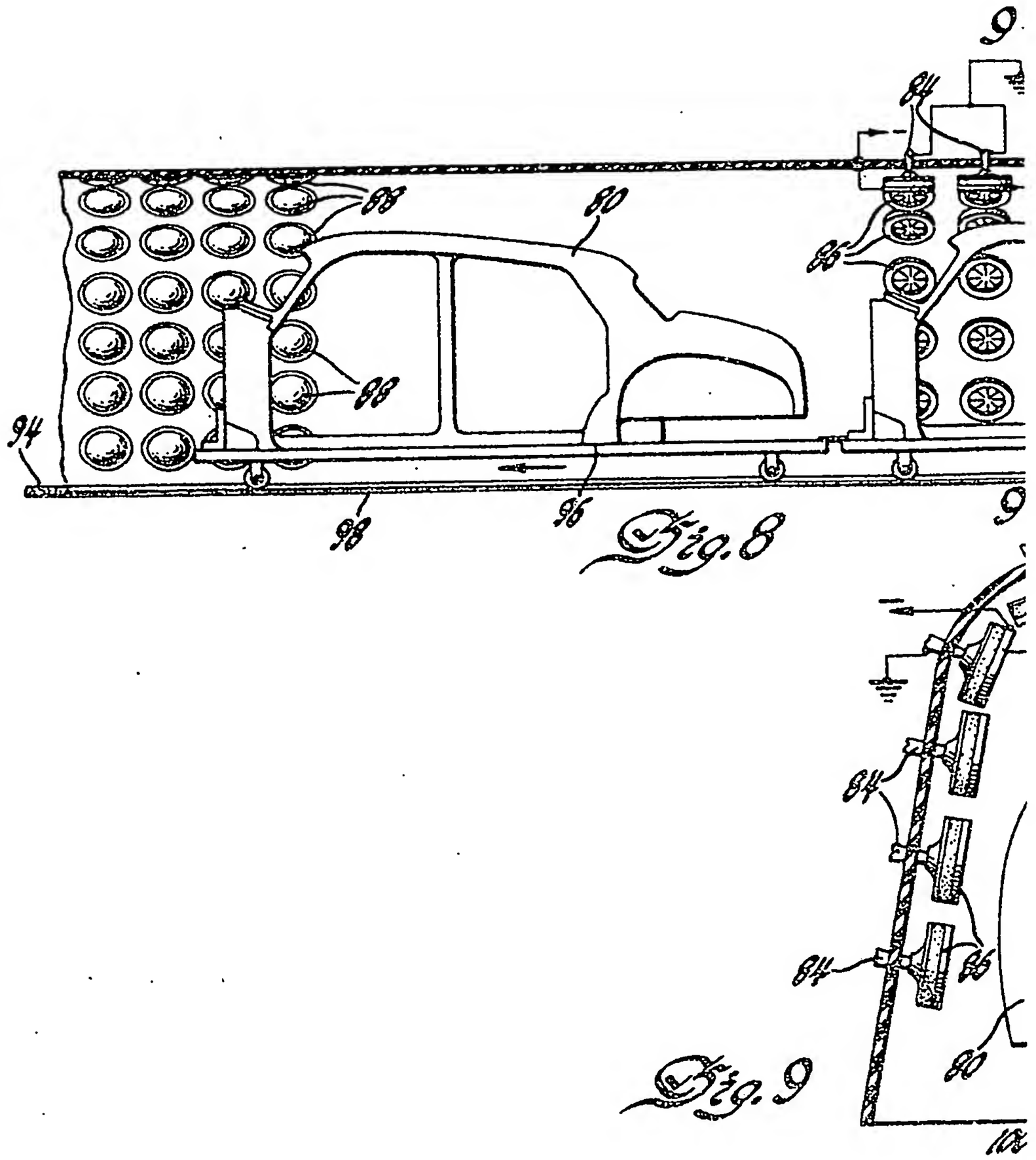

Fig. 8

Fig. 9

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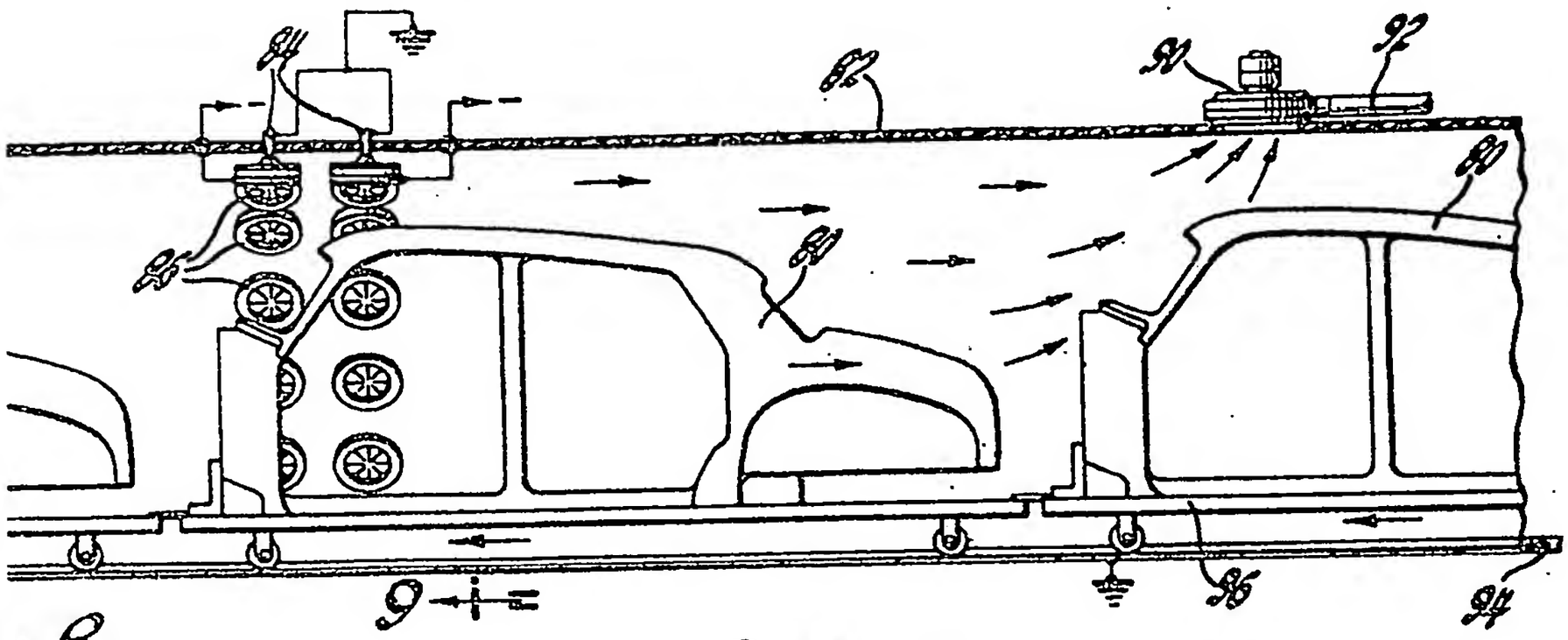

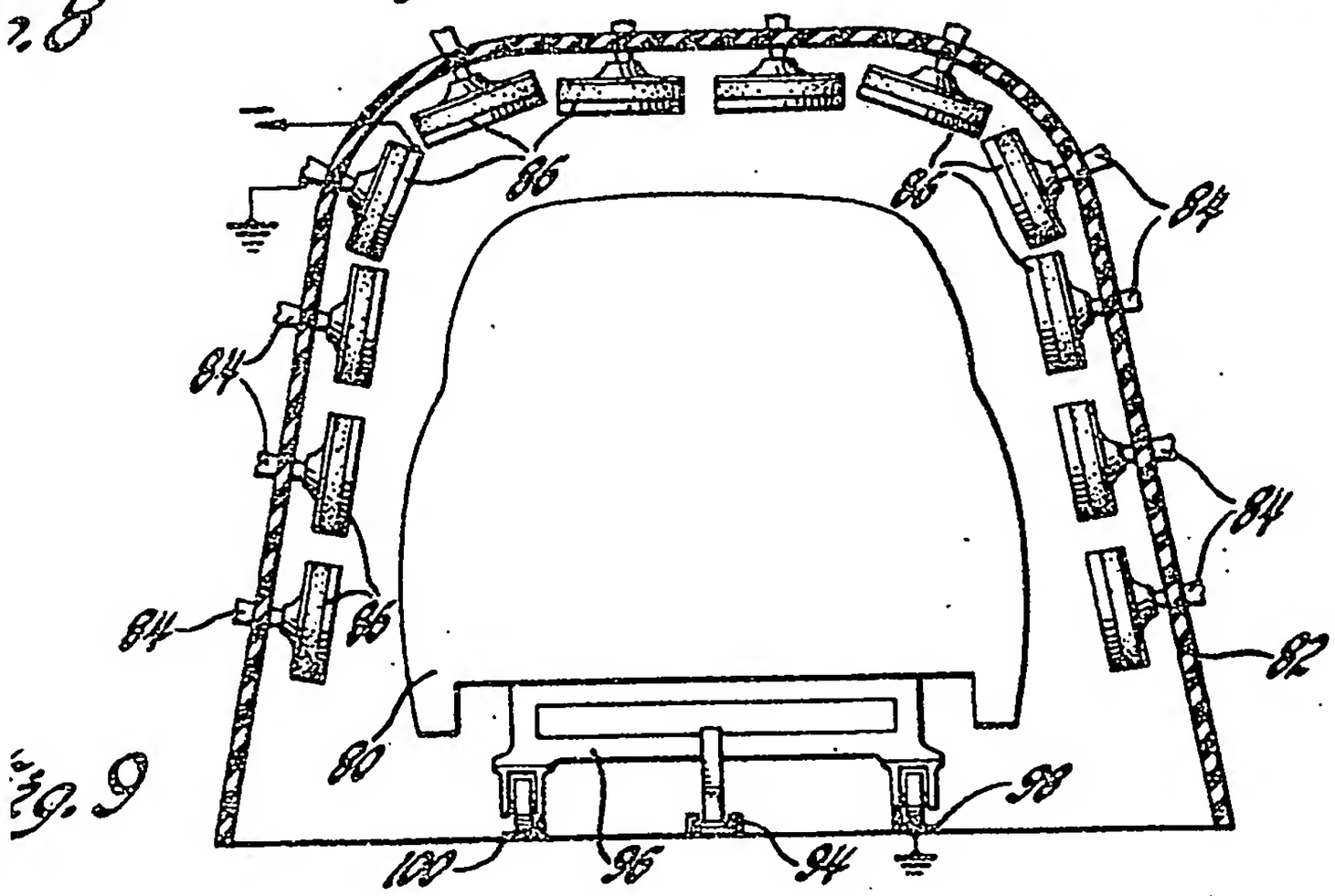

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SHEET 4

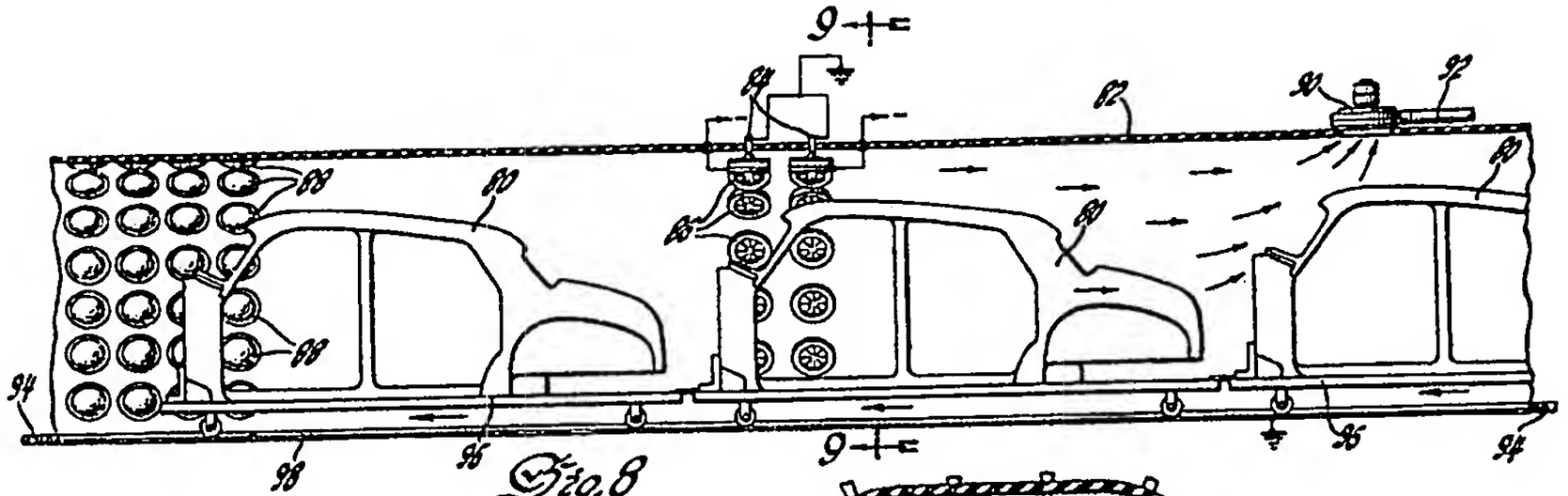

Fig. 8

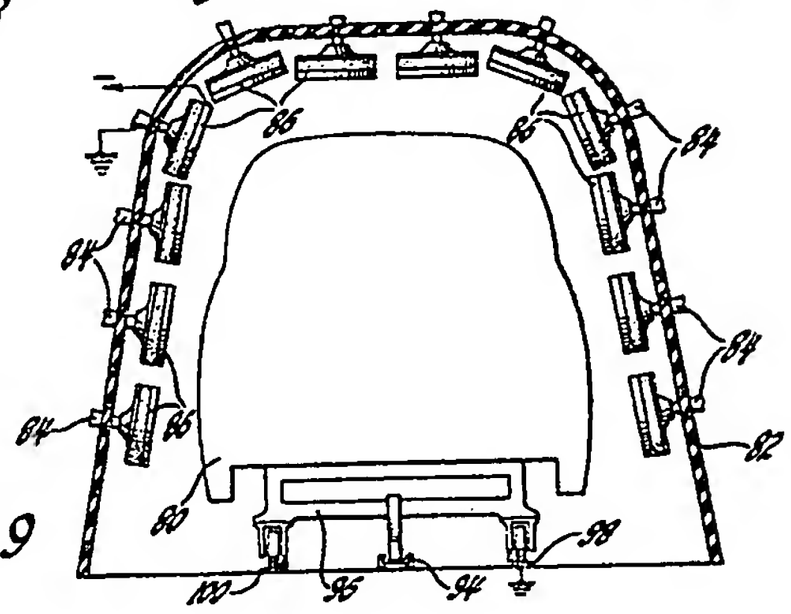

Fig. 9